

## Definitions: Mathematics

### Textbook according to Multan board for Class IX

This document contains all the definitions of Mathematic from the Textbook for Class IX. It has been done to help the students and teachers at no cost.

#### Chapter No.1

#### Matrix

A rectangular array of number arranged into rows and columns is called matrix

OR

The combination of rows and columns in square or rectangular form is called matrix.

#### Order of Matrix

The number of rows and columns in a matrix specifies its order. If a matrix M has  $m$  rows and  $n$  columns then M is said to be of order,  $m \times n$

e.g

$$M = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 0 & 2 \end{bmatrix} \text{ is order of } 2\text{-by-}3$$

#### Equal matrix

Two numbers are said to be equal if and only

They have same order

They corresponding entries are equal

e.g

$$A = \begin{bmatrix} 7 & 0 \\ 3 & 2 \end{bmatrix} \quad B = \begin{bmatrix} 4+3 & 0 \\ 3 & 2 \end{bmatrix} \text{ are equal}$$

#### Row Matrix

A matrix is called a row matrix, if it has only one row

e.g  $M = [5 \quad 3]$

#### Column Matrix

A matrix is called column matrix, if it has only one column

$$\text{e.g } M = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

#### Rectangular matrix

A matrix is called rectangular, if the number of rows not equal to number of columns

$$\text{e.g } M = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{bmatrix}$$

#### Square matrix

A matrix is called square matrix, if the number of rows are equal to number of columns

$$\text{e.g } H = \begin{bmatrix} 4 & 0 \\ 6 & 2 \end{bmatrix}$$

#### Null or Zero matrix

A matrix is called a Null or Zero matrix, if each of its entries is Zero (0)

**Square matrix**

A matrix is called square matrix, if the number of rows are equal to number of columns

e.g.  $H = \begin{bmatrix} 4 & 0 \\ 6 & 2 \end{bmatrix}$

**Null or Zero matrix**

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e.g.  $N = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

**Symmetric matrix**

A matrix is called symmetric matrix if  $A^t = A$

e.g.  $\begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$

**Skew Symmetric matrix**

A square matrix is called skew symmetric  $A^t = -A$

e.g.  $A = \begin{bmatrix} 0 & -4 \\ 4 & 0 \end{bmatrix}$

**Scalar matrix**

A matrix is called scalar matrix if all the diagonal entries are same

e.g.  $\begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$

**Diagonal matrix**

A square matrix is called diagonal matrix if at least any one of the entries of its diagonal is not zero and non diagonal entries must all be zero

e.g.  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

**Identity matrix**

A diagonal matrix is called identity (unit) matrix if all diagonal entries are 1

e.g.  $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

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**Singular matrix**

A square matrix is called singular matrix if the determinant of M is equal to zero i.e.  $|M|=0$

e.g.  $M = \begin{bmatrix} 4 & 4 \\ 3 & 3 \end{bmatrix}$   
 $|M| = \begin{vmatrix} 4 & 4 \\ 3 & 3 \end{vmatrix} = 12 - 12 = 0$

**Singular matrix**

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**Non singular matrix**

A square matrix is called non singular matrix, if the determinant  $M$  is not equal to zero

i.e.  $|M| \neq 0$

e.g.  $M = \begin{bmatrix} 6 & 2 \\ 3 & 4 \end{bmatrix}$

**Transpose of matrix**

A matrix obtained by changing the rows into columns or to columns in to rows of a matrix is called Transpose of matrix

$$A = \begin{bmatrix} 1 & 0 & 2 \\ 2 & -1 & 3 \end{bmatrix} \quad A' = \begin{bmatrix} 1 & 2 \\ 0 & -1 \\ 2 & 3 \end{bmatrix}$$

**Negative of matrix**

Let  $A$  be a matrix then its negative  $-A$  is obtained by changing the signs of all the entries.

$$A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix} \quad \text{Then } -A = \begin{bmatrix} -1 & 2 \\ -3 & -4 \end{bmatrix}$$

**CHAPTER # 2****REAL AND COMPLEX NUMBERS****Set of real number:**

Union of two disjoint sets, the set of rational number  $\mathbb{Q}$  and the set of irrational number  $\mathbb{Q}'$ .

$$\mathbb{R} = \mathbb{Q} \cup \mathbb{Q}'$$

**Complex Number:**

A number of the form  $Z = a + bi$  where  $a$  and  $b$  are the real numbers and  $i = \sqrt{-1}$  is called complex number.

e.g.  $Z = 6 + 2i$

**Complex conjugate:**

The number  $a + bi$  and  $a - bi$  are conjugate of each other.

**Rational Number:**

The number of the form  $\frac{p}{q}$  where  $p, q$  integers and  $q \neq 0$  are called rational numbers.

e.g.  $\frac{2}{3}, \sqrt{\frac{12}{25}}$

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The number  $a+bi$  and  $a-bi$  are conjugate of each other.

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e.g.  $\frac{2}{3}, \sqrt{\frac{16}{25}}$

**Irrational Number:**

The number which cannot be express in the form of  $\frac{p}{q}$  where  $p, q$  integers and  $q \neq 0$  are called irrational numbers.

e.g.  $\sqrt{2}, 3.14$

**Natural Numbers:**

The numbers 1, 2, 3, ... which we use for counting object are called natural numbers.

e.g.  $N = \{1, 2, 3, \dots\}$

**Whole Numbers:**

If we include 0 in the set of natural members then it is called whole number and it is denoted by  $W$ .

e.g.  $W = \{0, 1, 2, 3, \dots\}$

**Integers:**

Set of integers consist of positive integers, 0 and negative and is denoted by  $Z$ .

e.g.  $Z = \{\dots, -1, -2, -3, 0, 1, 2, 3, \dots\}$

**Radicals and Radicands:**

If a real number then any real number  $x$  such that  $x^n = y$  is called the  $n$ th root of  $y$ . In the radical  $\sqrt[n]{y}$ ,  $n$  is radical and  $y$  is called radicand.

**CHAPTER 3****LOGARITHM****Scientific Notation:**

Number written in the form  $a \times 10^n$  where  $1 \leq a < 10$  and  $n$  is an integer called scientific notation.

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LOGARITHMScientific Notation:

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Common Logarithm:

If the base of logarithm is taken as 10 then logarithm is called common logarithm.

Natural Logarithm:

Logarithm having base  $e$  is called Napier logarithm or Natural logarithm.

Characteristic:

The integral part of the logarithm of any number is called the characteristic.

Mantissa:

The decimal part of the logarithm of a number is called the mantissa and is always positive.

## CHAPTER 4

ALGEBRAIC EXPRESSIONS AND ALGEBRAIC FORMULASAlgebraic expression:

An algebraic expression is that in which constants and variables or both are combined by addition and subtraction.

e.g.  $5x^2 - 4x$

Rational expression:

The quotient  $p(x)/q(x)$  of two polynomial  $p(x)$  and  $q(x)$  where  $q(x) \neq 0$  is called a rational expression.

$$\text{e.g. } \frac{3x+1}{2x+3}$$

Surd:

An irrational radical with radicand is called a surd.

$$\text{e.g. } \sqrt{2}, 3\sqrt{7}$$


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Monomial Surd:

A surd which contain a single term is called monomial surd.

$$\text{e.g. } \sqrt{2}, \sqrt{3}$$

Binomial Surd:

A surd which contain sum of two monomial surds is called binomial surd.

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e.g.  $\sqrt{3} + \sqrt{7}$

**CHAPTER5****FACTORIZATION****Factorization:**

The process of expressing an algebraic expression in term of its factor is called factorization.

**Remainder theorem:**

If a polynomial  $f(x)$  is divided by a linear divisor  $(x-a)$ , then the remainder is  $f(a)$

**Factor theorem:**

The polynomial  $(x-a)$  is a factor of the polynomial  $f(x)$  if and only if  $f(a)=0$

**Zero of polynomial:**

If a specific number  $x=a$  is substituted for the variable  $x$  in a polynomial  $p(x)$  so that the value

$P(a)$  is zero then  $x=a$  is called zero of polynomial  $p(x)$

**CHAPTER6****ALGEBRAIC MANIPULATION****HCF (Highest common factor):**

If two or more algebraic expression are given then their common factor of highest power is called HCF of the expression.

**LCM (Least common multiple):**

The product of common factor together with non common factors of the given expression is called LCM.

**Relation between HCF and LCM:**

$LCM \cdot HCF = p(x) \cdot q(x)$  Where  $p(x)$  and  $q(x)$  are given expression.

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**Chapter No.7****LINEAR EQUATION & INEQUALITIES****EQUATION**

An equation is a statement that says the two given algebraic expressions are

e.g.  $x+2=3$

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**LINEAR EQUATION**

A linear equation in one unknown variable  $x$  is an equation of the form  $ax+bs=c$

$A, b \in \mathbb{R}$  and  $a \neq 0$

**Types of equations****IDENTITY EQUATION**

An identity is an equation that is satisfied by every number for which both sides are defined

e.g.  $x+3=3+x$

**CONDITIONAL EQUATION**

A conditional equation is an equation that is satisfied by at least one number but is not an identity

Eg.  $2x+1=9$

**INCONSISTENT EQUATION**

An inconsistent equation is an equation whose solution set is the empty set

Eg.  $x+x=5$  because no value of  $x$  satisfies it

**RATIONAL EQUATION**

When the variable in an equation occurs under a radical sign the equation is called rational equation

e.g.  $\sqrt{2x-3} - 7 = 0$

**EXTRANEIOUS SOLUTION**

A solution that does not satisfy the original equation is called extraneous solution

**LINEAR INEQUALITY IN ONE VARIABLE**

A linear inequality in one variable  $x$  is an inequality in which the variable  $x$  occurs only to the first power and is of the form

$ax+b < 0$  or  $a > 0$

Chapter No.8LINEAR GRAPHS AND THEIR APPLICATIONS**1. CARTESIAN PLANE**

The plane formed by two straight lines perpendicular to each other is called Cartesian plane.

**2. CO-ORDINATE AXES**

The line intersecting each other perpendicularly are called Co-Ordinate Axes.

Chapter No.8LINEAR GRAPHS AND THEIR APPLICATIONS**1. CARTESIAN PLANE**

The plane formed by two straight lines perpendicular to each other is called Cartesian plane.

**2. CO ORDINATE AXES**

The line intersecting each other perpendicularly are called Co-Ordinate Axes.

**3. ORDER PAIR OF ELEMENTS**

An order pair is a pair of elements in which elements are written in specific order

**4. ORIGIN**

The point of intersection of two co-ordinate axes is called origin.

**5. ABSCISSA AND ORDINATE**

The x co ordinate of point is called Abscissa and y co ordinate is called ordinate

e.g. (3,6) have 3 is Abscissa and 6 is ordinate

**6. COLLINEAR POINT**

The set of points which lie on the same line are called Collinear point

Chapter No.9INTRODUCTION TO CO-ORDINATE GEOMETRY**1. PLANE GEOMETRY AND CO-ORDINATE GEOMETRY**

The study of geometrical shapes in a plane is called plane geometry. Co-ordinate geometry is the study of geometrical shapes in the Cartesian plane

**2. DISTANCE FORMULA**

The distance between two points A( $x_1, y_1$ ) and B ( $x_2, y_2$ ) is define as

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**3. COLLINEAR POINT**

Two or more than two points which lie on the same straight line are called collinear point.

**4. NON COLLINEAR POINT**

Points are non collinear if they do not lie on the same straight line are called non collinear point

**5. RECTANGLE**

A figure formed in the plane by four non collinear points is called a rectangle if

- Its opposite sides are of equal measure
- Its opposite sides are parallel to each other

**6. PARALLELOGRAM**

A figure formed by four non collinear point in the plane is called parallelogram if

- Its opposite sides are of equal measure



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#### 6. PARALLELOGRAM

A figure formed by four none collinear point in the plane is called parallelogram if

- Its opposite sides are of equal measure
- Its opposite sides are parallel
- Measure of none of the angle is  $90^\circ$

#### 7. EQUILATERAL TRIANGLE

If the length of all the three sides of a triangle are same then the triangle is called an equilateral triangle

#### 8. ISOSCELES TRIANGLE

If length of two sides of the triangle is equal and length of the 3<sup>rd</sup> side is different then that triangle is called isosceles triangle

#### 9. RIGHT TRIANGLE

A right triangle is that in which one of the angles has measure equal to  $90^\circ$

#### 10. SQUARE

A square is a closed figure in the plane formed by four non collinear points such that length of all sides equal and measure of each angle is  $90^\circ$

#### 11. Scalene triangle

If measure of three sides of the triangle are different then the triangle is called scalene triangle

### Chapter No.10

#### CONGURENT TRIANGLES

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Two triangles are said to be congruent if there exists a Correspondence between them such that all the corresponding sides and angles are congruent

#### ASA postulate

In any correspondence of two triangles if one side and any angles of the triangle are congruent to the corresponding sides and angles of the other then the triangle are congruent. This statement is called ASA postulate

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#### SSS postulate

In any correspondence of two triangles if three sides of a triangle are congruent to the corresponding sides of the other then the triangles are congruent. This statement is called SSS postulates

#### H.S postulate

In any correspondence of two right angles triangles if hypotenuse and one side of a triangle are congruent to

**SSS postulate**

In any correspondence of two triangles if three sides of a triangle are congruent to the corresponding three sides of the other then the triangles are congruent. This statement is called SSS postulates.

**HS postulate**

In any correspondence of two right angles triangles if hypotenuse and one side of a triangle are congruent to the corresponding hypotenuse and side of the other then the triangles are congruent.

**Chapter No.11****PARALLELOGRAM AND TRIANGLES****TRAPEZIUM**

A trapezium is a quadrilateral with two parallel sides and two non parallel sides

**PARALLELOGRAM**

If two opposite sides of a quadrilateral are congruent and parallel. It is a parallelogram

**RECTANGLE**

A rectangle is a parallelogram with all the angles at the vertices equal to  $90^\circ$

Area of rectangle = length  $\times$  width

Q. How many congruent triangles are formed by each diagonal parallelogram. Draw a diagram

Ans. Each diagonal of a parallelogram bisect it into two congruent triangles

$\triangle AHD$  and  $\triangle BCD$  are two triangles

Q. If the line segment joining the mid points of the sides of a triangle is parallel to third side what is the relation with  $3^{rd}$  side?

Ans. If the line segment joining the mid point of the sides of a triangle is parallel to the  $3^{rd}$  sides and is equal one half of its length here

**Chapter No.12****LINE BISECTOR AND ANGLE BISECTOR****Right bisector of a line segment**

A line  $l$  is called a right bisector of a line segment if  $l$  is perpendicular to the line segment and passes through its mid point

**Angle bisector**

Angle bisector is the ray which divide an angle into two equal parts

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**Chapter No.13****SIDES AND ANGLES OF A TRIANGLE****Scalene triangle**

A triangle is called scalene triangle if measure of all the sides is different

Q. If two sides of a triangle are unequal in length then which angle will be of greater measure?

Ans. If two sides of a triangle are unequal in length the longer sides has an angle of greater measure

**Chapter No.13****SIDES AND ANGLES OF A TRIANGLE****Scalene triangle**

A triangle is called scalene triangle if measure of all the sides is different

Q. If two sides of a triangle are unequal in length then which angle will be of greater measure ?

Ans. If two sides of a triangle are unequal in length the longer sides has an angle of greater measure opposite to it.

Q. In a scalene triangle what will be the measure of angle opposite to the largest side ?

Ans. In a scalene triangle the angle opposite to the largest side is of measure greater than  $60^\circ$

Q. Which side of a right angle triangle is longer than each of other two sides ?

Ans. The hypotenuses of right angle triangle is longer than each of other two sides

**Chapter No.14****RATIO AND PROPORTION****RATIO**

Ratio  $a : b = \frac{a}{b}$  is the comparison of two alike quantities having same unit

**PROPORTION**

The equality of two ratios is called proportional four number a,b,c,d are in proportion if  $A:B=C:D$

**Similar triangles**

Triangles are called similar if they are equiangular and measure of their corresponding sides are proportional

**Practical application of similar triangle**

Photographer can develop prints of different sizes from the same negative. In spite of the difference in sizes.

There pictures look like each other. One photograph is simply an enlargement of another

**Congruent triangles**

Two triangles are said to be congruent if there exists a correspondence between them. Such that all the corresponding sides are angles are congruent

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**Chapter No.15****PYTHAGORAS THEOREM****Pythagoras Theorem**

In a right angle triangle the square of the length of hypotenuse is equal to the sum of the square of the length of the other two sides

$$(Hyp)^2 = (base)^2 + (perp)^2$$

**Right triangle**

A right triangle is that in which one of the angles has measure equal to  $90^\circ$

## Chapter No.15

## PYTHAGORAS THEOREM

## Pythagoras Theorem

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$$(Hyp)^2 = (base)^2 + (perp)^2$$

## Right triangle

A right triangle is that in which one of the angles as measure equal to 90°

## Acute angle triangle

If sum of square of two sides is greater than the square of 3<sup>rd</sup> side then the angle is called acute angle triangle

$$a^2 + b^2 > c^2$$

## Obtuse angle triangle

The triangle in which of sum of squares are two sides is less then the square of 3<sup>rd</sup> side is called obtuse angle triangle

## Chapter No.16

## THEOREMS RELEATED WITH AREA

## Area of the figure.

The region enclosed by bounding lines of a closed figure is called the area of the figure

## Triangular region

A triangular region is the union of a triangle and its interior i.e The three line segments forming the triangle and its interior

## Rectangular region

A Rectangular region is the union of a rectangle and its interior

## Parallel lines

Two lines which on extending in both the directions infinitely never intersect at a point are called parallel lines

## Parallelogram

A parallelogram is a quadrilateral in which opposite sides are parallel opposite sides are of equal length and the measure of opposite angles are equal

## Altitude or height of a parallelogram

If one side of parallelogram is taken as its base the perpendicular distance between that sides parallel to it is called altitude or height parallelogram

## Chapter No.17

## PRACTICAL GEOMETORY TRIANGLE

## Centroid of a triangle

The point where the three medians of a triangle meet is called centroid of the triangle

## Circumcentre of a triangle

The point of concurrency of three tight bisectors of sides of triangle is called its circumcentre.